

city except portions upon two hills inundated. The water on Main street rose to the height of eight feet; the first floor of every business house from one to five feet under water; many buildings washed away and over twenty persons reported drowned. Lampasus, Tex., heaviest rain for many years; mail stage washed away and driver drowned; much other damage. Vincennes, Ind., 21st, creeks "terribly" swollen; great damage to growing wheat. Fences, bridges, and railroad embankments washed away. A brick-yard near town was submerged and a quarter of a million bricks were washed away. Sullivan, Ind., 21st, severe washouts and much other damage. Huntington, Ind., 21st, Flint Creek overflowed, causing considerable damage, railroad tracks submerged and culverts washed away. Wabash, Ind., 21st, great damage to fences, bridges and crops; stream everywhere overflowed, bottom lands 2 to 10 feet under water; trains delayed. Columbus, Ga., 21st, all railroads broken, no trains running, 67 bridges washed away throughout the county, low lands submerged and all crops damaged; river rose 15 feet in two hours; streets converted into rushing rivers; houses flooded several feet deep; calves, goats, hogs, dogs, and fowl drowned by the score.

**Drought.**—The following will serve to show the extent of drought in the various sections. Cheyenne, driest month in the past 9 years. Independence, Kan., 28th, first rain in 6 weeks; wheat and oats suffered severely. Bowling Green, Ky., 1st to 20th, exceedingly dry; all crops suffering, oat crop a failure, market gardens seriously damaged. Fallston, Md., 31st, grass and wheat seriously injured; no rain from April 29th to May 22d. Sandy Springs, Md., month unusually dry; all crops suffering. South Lee, Mass., month very dry; "mills on the Housatonic river used all the water on the 24th, an event which has not happened before in 70 years, notwithstanding that the streams have been higher this year than usual." Clear Creek, Neb., 26th, first good rain since last fall; crops suffering. Auburn, N. H., 18th to 30th, very dry; vegetation suffering severely. Freehold, N. J., month unusually dry. Atco, N. J., 31st, strawberry and hay crops seriously damaged. Somerville, N. J., drought very severe throughout the month. White Plains, N. Y., smallest monthly rain-fall in the past 7 years. Catawissa, Pa., throughout month, seriously damaging grain and grass crops. Fallsington, Pa., 22nd, first rain in 23 days; month unusually dry. Litchfield, Pa., 20th, much damage to grain and vegetables. Snowville, Va., 1st to 21st, severe drought. Walnut Grove, Va., no rain from 1st to 21st; crops suffering severely. Norfolk, Va., 28th, unprecedented drought in neighboring country; first and early vegetables damaged to a large extent. Helvetia, W. Va., 1st to 19th, unusually dry; rivers and streams lowest for many years. Omaha, Neb., drought in eastern part of state unprecedented: six months without rain enough to wet the ground: the air is filled with dust.

**Rain from a Cloudless Sky.**—Burlington, Vt., 10th, 26th.

**Precipitation during April, received after the issue of April Review.**—*Arizona*: Whipple Barracks, 0.14 inch.; Fort Lowell, 0.16; Fort Bowie, 0.15; Fort Verde, 0.27; Fort McDowell, 0.28; Fort Apache, 0.46; Fort Grant, 0.04; Fort Mojave, 0.00; Fort Thomas, 0.06. *California*: Benicia Barracks, 8.15; Salinas City, 3.90; Oakland, 8.46; Poway, 3.10; Angel Island, 10.17; Presidio, S. F. Cal., 7.55; Fort Gaston, 13.95; Mount St. Helena, 27.87; San Geronimo, 6.94; San Buenaventura, 1.87. *Dakota*: Fort Stevenson, 5.66; Fort Sully, 1.71; Fort Meade, 0.75. *Idaho*: Fort Lapwai, 0.23. *Montana*: Fort Benton, 1.80; Fort Shaw, 1.51; Fort Ellis, 4.24; Fort Keogh, 1.10; Fort Logan, 1.45; Fort Assiniboine, 1.29; Blackfeet Agency, 0.91. *Oregon*: Albany, 2.62; Fort Stevens, 4.83; Fort Klamath, 2.77; Eola, 2.21; Fort Harney, 1.70. *Texas*: Fort Ringgold, 0.70; Fort Brown and Fort Davis, 0.00; Fort Elliot, trace; Laredo, 1.20. *Virginia*: Dover Mines, 1.30. *Washington, Ter.*: Fort Canby, 4.03; Fort Townsend, 1.30; Neah Bay, 3.52; Bainbridge Island, 2.15; Dayton, 3.81. *Florida*: Okahumpka, 2.12; Daytona, 2.28. *Massachusetts*: Williamstown, 4.77. *Michigan*: Grand Rapids, 6.00. *Nevada*: Wadsworth, 0.87; Brown's, 0.94. *New Jersey*: South Orange, 3.02. *New York*: Troy, 2.07. *Pennsylvania*: Chambersburg, 3.07. *Tennessee*: McMinnville, 7.50; Austin, 5.38; Clarkville, 5.65; *Utah*: Promontory, 2.03; Terrace, 0.30.

## RELATIVE HUMIDITY.

The percentages of mean relative humidity for the month range as follows: New England, from 59.6 to 77.3; Middle Atlantic States, 53.9 to 77.4; South Atlantic States, 58.2 to 77.5; Eastern Gulf States, 71.0 to 77.5; Western Gulf States, 68.9 to 78.3; Ohio valley and Tennessee, 55.1 to 67.9; Lower Lake region, 55.4 to 66.5; Upper Lake region, 59.8 to 75.5; Upper Mississippi valley, 54.3 to 61.6; Missouri valley, 51.1 to 56.4; Red River of the North valley, 65.2 to 67.6; Eastern Rocky Mountain Slope, 41.0 to 85.0; Western Plateau, 10.0 to 49.7; California, 50.6 to 72.0; Oregon, 65.0 to 73.0. *High stations* report the following averages not corrected for altitude: Pike's Peak, 63.5; Mt. Washington, 83.3 per cent.

## WINDS.

The *prevailing direction of the winds* for the month of May, 1880, is shown, by arrows flying with the wind, on chart No. II. The prevailing winds over the eastern half of the United States were *southerly*, and along the Pacific coast, over the Plateau districts, and in the Upper Missouri valley *northwesterly* or *westerly*. Exceptions to the above generalization are to be found in the northwest winds on the summit of Mt. Washington, at New York, Pittsburg and Marquette; in the northeast winds at Duluth and Jacksonville; in the east winds at Brackettville, McKavett, Indianola, New Orleans, Atlanta, Montgomery, Cedar Keys, Punta Rasa and Key West; and in the southerly winds at Los Angeles and Olympia.

*Total Movements of the Air.*—The following are the largest total movements at the Signal Service stations: Pike's Peak, 19,287 miles; North Platte, 14,329; Chincoteague, 12,905; Breckenridge, 12,107; Delaware Breakwater, 12,034; Fort Elliott, Tex., 11,948; Dodge City, 11,564; Kittyhawk, 11,504; Stockton, 11,462; Fort Sill, 11,006; Cape May, 10,994; Cape Lookout, 10,826; Wood's Holl, 10,839; Cape Hatteras, 10,707; Bismarck, 10,596; Cape Henry, 10,496; Thatcher's Island, 10,081; Yankton, 9,943; Sandy Hook, 9,855; Concho, 9,788; Barnegat, 9,709; Sandusky, 9,457; Indianola, 9,456; Henrietta, Tex., 9,404; Umatilla, 9,343; Pembina, 9,260; Milwaukee, 9,212; Decatur, 9,047; Grand Haven, 8,832; Philadelphia, 8,367; Cheyenne, 8,354; Omaha, 8,344; San Francisco, 8,320; Cedar Keys, 8,278; Red Bluff, 8,249; Boston, 8,117; St. Paul, 8,115; Key West, 8,039; St. Louis, 8,000. Frost-work prevented a complete record on Mt. Washington. The *smallest* are: Augusta, 2,366; La Mesilla, 2,385; Silver City, 2,442; Deadwood, 2,613; Lynchburg, 2,728; Knoxville, 2,800; Roseburg, 2,882; Shreveport, 2,981; Nashville, 3,050; Tucson, 3,159; Little Rock, 3,327; Des Moines, 3,473; Los Angeles, 3,508; Uvalde, 3,547; Fort Davis, Tex., 3,556; Morgantown, 3,562; Visalia, 3,621; Chattanooga, 3,625; Vicksburg and Laredo, 3,802; Cincinnati, 3,963; Montgomery, 3,997.

*Local Storms.*—An unusual number of severe local storms were reported during the month. They occurred on the 8th, 9th and 10th, during the passage of low area No. IV, and from the 20th to the 29th, during the passage of low areas Nos. VI, VII, VIII and IX. Kalamazoo, Mich., 8th, 11 p. m.—Violent tornado two miles east of station, demolishing houses, trees and fences; St. Barnabas Chapel, 25 by 40 feet, was moved four feet off from foundation; the cloud appeared to have bounded over many places. Hudson and Thornville, Mich., 8th, very violent wind and rain-storm, causing much damage to buildings and fences. Yates Center, Kan., 9th, 5 p. m., a severe tornado passed from SW. to NE., a few miles north of station; the cloud appeared as a long serpent-like column of dense black smoke; many buildings were destroyed and several persons severely injured. Lincoln county, Mo., 9th, between noon and 1 p. m., a severe tornado started in Highland Prairie, moving in a northeast direction, demolishing trees, fences and buildings; width of path about 200 yards wide. Jacksonville, Ill., 10th, 9 p. m., violent tornado passed along the valley of Big Sandy creek, eight miles south of the town, destroying everything in its path; 20 to 30 buildings were demolished and miles of fencing laid waste; 25 head of cattle and horses, 30 head of sheep, and seven persons were killed; width of path about 1 mile, and course from SW. to NE. Alsey, Ill., 10th, 7 p. m., a severe tornado; not a dozen houses remained standing within city limits; two black and fearful-looking clouds, one from northwest and the other from southeast met west of the city, from which immediately descended a funnel-shaped cloud, when the work of destruction commenced, and in less than three minutes the entire damage was completed. Arrowsmith, Ill., 10th, very violent wind and rain-storm passed over city during early morning, doing a vast amount of damage to buildings; several persons were dangerously injured; loss estimated at \$100,000. Clinton, Ill., 10th, heavy wind and rain-storm during evening; buildings, fences and trees demolished; path very narrow, and course from SW. to NE. Woodlawn, Morgan Co., Ill., 10th, tornado destroyed railroad station and other buildings; four persons killed; path from SW. to NE. Island Pond, Vt., 10th, terrific wind-storm, destroying several buildings, steamboat house and a large covered bridge 200 feet long. Carbondale, Ill., 20th, 2 p. m., violent tornado struck the southern end of the town, unroofing and demolishing houses, and blowing down trees and fences. State Normal University building very seriously damaged. One of the heavy caissons of the artillery park was driven violently for a distance of nearly 100 yards. Course of storm from SW. to NE. Grafton, N. H., 20th, small but violent tornado during afternoon; the largest trees were uprooted or broken off, and fences and buildings damaged. Hail of large size accompanied the storm, some of the stones were pronged shaped, two inches long by one wide. Path of storm from SW. to NE. Wakarusa, Ohio, 22d, 5:20 p. m., violent tornado passed through the northern portion of Wakarusa township and across Florence and Vermillion townships to Lake Erie, doing a vast amount of damage to dwellings, barns, orchards, timber and fences. "The first evidence of the storm was indicated by a violent conflict of the air currents overhead, driving the clouds in every direction; shortly afterwards a spout like cloud was seen to descend from the clouds to the ground, having a spiral motion from right to left, rapidly assuming greater proportions with increased violence. Solid oak trees, three to five feet in diameter, were twisted off like brittle pipe-stems; animals were carried long distances and dashed in shapeless masses, and poultry were stripped of their feathers and yet found alive. Few trees of any kind were blown over at the roots, being generally twisted off, from four to twenty-five feet from the ground. The funnel-shaped cloud appeared to alternately increase and decrease in size as it moved forward with a swaying motion from side to side. Seen at a distance, the storm-cloud seemed filled with objects resembling immense birds sailing around in the spirally moving current, but which proved to be large branches and pieces of timber." Path, fifteen to thirty rods in width and eight to ten miles in length; course, SSW. to NNE.; loss, \$25,000. Freedom, Ohio, 22nd, 7 p. m., severe wind and rain-storm; many buildings crushed to the earth and swept away; miles of fencing and much valuable timber demolished. Omaha, 23rd, 6:15 p. m., small tornado passed through the northern part of the city, from NW. to SE.; width of path about six hundred feet. The catholic convent and several residences were demolished. Immense clouds of dust accompanied the storm, and fence and telegraph wires were blown down in great confusion. At Council Bluffs several buildings were unroofed and freight cars overturned. Mitchell, Dak., 25th, 7 p. m., severe tornado, three persons killed and many buildings destroyed. Most of the farm buildings in the vicinity of the town were blown to pieces. Course of storm from SW. to NE. Independence, Ia., 25th, 4:30 p. m., terrific wind and rain storm, much damage to property. Albany, N.

Y., 26th, 4:25 p. m., very violent wind storm, trees uprooted and fences and buildings demolished. Savoy, Tex., 28th, during the evening this town was almost entirely destroyed by a violent tornado, 15 persons killed and 60 wounded. At Suffield, Conn., on the 29th, about 1:30 p. m., a violent tornado, accompanied with torrents of rain and very heavy hail, passed from SW. to NE. through the township, crossing the Connecticut river directly opposite Thompsonville, where it lifted large bodies of water and demolished boats. In Thompsonville and also through the remaining portion of Enfield township to the eastward the destruction to property was very severe. From 20 to 30 buildings, several fine orchards and groves of choice forest trees were demolished. Width of storm track, about one mile, the boundary lines of destruction on either side being sharply defined, objects in close proximity escaping the slightest injury. In less than 10 minutes from the time the dark clouds were first seen in the west the entire destruction throughout Suffield was completed. The whirling action of the storm cloud was clearly evidenced by the peculiar twisting of the trees from right to left and the spreading of the debris in circles. The loss was estimated at from \$30,000 to \$40,000.

*Sand-storms.*—Umatilla, Oregon, 7th; Winnemucca, 2nd, 3rd, 4th, 22nd, 23rd; Burkes, Arizona, 12th, 13th, 22nd, 23rd, 24th, 25th; Colorado Springs, Colorado, 14th; North Platte, 11th, 12th, 13th, 14th; Yankton, 4th; Fort Garland, Col., 6th, 17th, 21st; Fort Union, N. M., 6th, 7th, 9th, 12th, 13th, 14th, 25th.

*Waterspouts.*—April 23rd, Schooner A. K. Bently in latitude 31°, 59', N. longitude 79°, 20', W., reported a remarkable waterspout in the SE., distant about one mile from vessel. It appeared to be an immense volume of water pouring from a dense black cloud. Yates Center, Kan., May 9th, waterspout burst on Vermillion river, 6 miles west of station, raising the water 16 feet in 20 minutes; thousands of fish were killed, not only where the spout burst, but for several miles below. Punta Rassa, Fla., 10th, between 5:50 and 6:05 p. m. a waterspout was seen near Sanibel Island, about two miles from observer, resembling the tall trunk of a coconut palm; it was of uniform diameter and brilliant whiteness. Altitude 20° and slightly inclined from the perpendicular at the top towards the east. The base for an apparent distance of 30 or 40 feet, was surrounded by a violently agitated mass of water. The body was a hollow cylinder composed of spray and water ascending with a rapid spiral motion from right to left; it moved from NE. to SW. and vanished from the bottom upwards. On Mustang creek, 4½ miles east of Colorado or Concho river, Texas, on the 28th, a huge waterspout, accompanied by an indescribable hissing, roaring noise, passed down the creek, drowning the horses of a party camped near by, and carrying away all their camp equipage and wagons; thousands of fish were thrown upon the banks.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily indications for May, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 82.8 per cent. The percentages for the four elements are: Weather, 88.3; Direction of the Wind, 81.6; Temperature, 79.0; Barometer, 81.7 per cent. By geographical districts they are: for New England, 77.4; Middle States, 82.6; South Atlantic States, 90.4; Eastern Gulf States, 87.7; Western Gulf States, 86.2; Lower Lake region, 80.6; Upper Lake region, 81.5; Tennessee and the Ohio valley, 83.0; Upper Mississippi valley, 80.7; Lower Missouri valley, 77.3; Northern Pacific region, 84.2; Central Pacific coast region, 85.5; Southern Pacific coast region, 87.5. There were 17 omissions to predict out of 3,813, or 0.45 per cent. Of the 3,796 predictions that have been made, 127, or 3.35 per cent, are considered to have entirely failed; 219, or 5.77 per cent, were one-fourth verified; 430, or 11.33 per cent, were one-half verified; 585, or 15.41 per cent, were three-fourths verified; 2,435, or 64.14 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

*Cautionary Signals.*—188 Cautionary Signals were displayed during the month, of which 142, or 75 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 33 Off-shore Signals were displayed, of which 27, or 81.8 per cent, were fully justified; 28, or 84.8 per cent, were justified as to velocity and 32, or 97.0 per cent as to direction. 6 of the Off-shore were changed from Cautionary. 221 Signals of both kinds were displayed, of which 169 or 76.5 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 114 cases of winds of 25 miles and over per hour, from scattered stations, were reported, and for which signals had not been ordered.

## NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river gauges for the month of May, 1880, with the dates of the same. As a general rule the rivers fell throughout the month. The *Red River*, at Shreveport, and the *Arkansas*, at Little Rock, fell steadily throughout the month. The *Missouri* and *upper Mississippi* changed but little throughout the month. The *Mississippi*, at Cairo, rose three feet from the 1st to the 6th, fell slowly to the 28th, and rose two feet to end of month; at Memphis it rose from the 1st to the 11th, after which it fell to end of month; at Vicksburg the water fell slowly from the 1st to the 5th, and remained almost stationary thence to 15th, on the 15th a more decided fall, which continued to end of month, set in and the water passed below the danger-line on gauge, after having been above that point for a period of 9 weeks; at New Orleans the water fell slowly throughout the month, passing the danger-line on the 26th, after having been above that point